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Scheffler, Brian E.
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Dayan, Franck E.
Arias de Ares, Renee S.

<120> HERBICIDE-RESISTANT PLANTS, AND POLYNUCLEOTIDES AND METHODS FOR PROVIDING SAME

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<170> PatentIn Ver. 2.1

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Tyr Thr Ser Phe Ala Val Lys Lys Leu Val Ser Arg Asn Lys Gly Arg
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aga tca cac cgt aga cat cct gcc ttg cag gtt gtc tgc aag gat ttt
548
Arg Ser His Arg Arg His Pro Ala Leu Gln Val Val Cys Lys Asp Phe
55 60 65

cca aga cct cca cta gaa agc aca ata aac tat ttg gaa gct gga cag
596
Pro Arg Pro Pro Leu Glu Ser Thr Ile Asn Tyr Leu Glu Ala Gly Gln

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                70                  75                  80

ctc tct tca ttt ttt aga aac agc gaa cgc ccc agt aag ccg ttg cag
644
Leu Ser Ser Phe Phe Arg Asn Ser Glu Arg Pro Ser Lys Pro Leu Gln
          85                  90                  95

gtc gtg gtt gct ggt gca gga ttg gct ggt cta tca aca gcg aag tat
692
Val Val Val Ala Gly Ala Gly Leu Ala Gly Leu Ser Thr Ala Lys Tyr
     100                 105                 110

ctg gca gat gct ggc cat aaa ccc ata ttg ctt gag gca aga gat gtt
740
Leu Ala Asp Ala Gly His Lys Pro Ile Leu Leu Glu Ala Arg Asp Val
115                 120                 125                 130

ttg ggt gga aag gta gct gct tgg aag gat gaa gat gga gat tgg tac
788
Leu Gly Gly Lys Val Ala Ala Trp Lys Asp Glu Asp Gly Asp Trp Tyr
                135                 140                 145

gag act ggg ctt cat ata ttt ttt gga gct tat ccc aac ata cag aat
836
Glu Thr Gly Leu His Ile Phe Phe Gly Ala Tyr Pro Asn Ile Gln Asn
           150                 155                 160

ctg ttt ggc gag ctt agg att gag gat cgt ttg cag tgg aaa gaa cac
884
Leu Phe Gly Glu Leu Arg Ile Glu Asp Arg Leu Gln Trp Lys Glu His
      165                 170                 175

tct atg ata ttc gcc atg cca aac aag cca gga gaa ttc agc cgg ttc
932
Ser Met Ile Phe Ala Met Pro Asn Lys Pro Gly Glu Phe Ser Arg Phe
 180                 185                 190

gat ttc cca gaa act ttg cca gca cct ata aat ggg ata tgg gcc ata
980
Asp Phe Pro Glu Thr Leu Pro Ala Pro Ile Asn Gly Ile Trp Ala Ile
195                 200                 205                 210

ttg aga aac aat gaa atg ctt act tgg ccg gag aag gtg aag ttt gca
1028
Leu Arg Asn Asn Glu Met Leu Thr Trp Pro Glu Lys Val Lys Phe Ala
                215                 220                 225

atc gga ctt ctg cca gca atg gtt ggt ggt caa cct tat gtt gaa gct
1076
Ile Gly Leu Leu Pro Ala Met Val Gly Gly Gln Pro Tyr Val Glu Ala
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caa gat ggc tta acc gtt tca gaa tgg atg aaa aag cag ggt gtt cct
1124
Gln Asp Gly Leu Thr Val Ser Glu Trp Met Lys Lys Gln Gly Val Pro
      245                 250                 255
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gat cgg gtg aac gat gag gtt ttt att gca atg tcc aag gca ctc aat
1172
Asp Arg Val Asn Asp Glu Val Phe Ile Ala Met Ser Lys Ala Leu Asn
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1220
Phe Ile Asn Pro Asp Glu Leu Ser Met Gln Cys Ile Leu Ile Ala Leu
275                 280                 285                 290

aac cga ttt ctt cag gag aag cat ggt tct aaa atg gca ttc ttg gat
1268
Asn Arg Phe Leu Gln Glu Lys His Gly Ser Lys Met Ala Phe Leu Asp
                295                 300                 305

ggt aat ccg cct gaa agg cta tgc atg cct att gtt gat cac att cgg
1316
Gly Asn Pro Pro Glu Arg Leu Cys Met Pro Ile Val Asp His Ile Arg
            310                 315                 320

tct agg ggt gga gag gtc cgc ctg aat tct cgt att aaa aag ata gag
1364
Ser Arg Gly Gly Glu Val Arg Leu Asn Ser Arg Ile Lys Lys Ile Glu
        325                 330                 335

ctg aat cct gat gga act gta aaa cac ttc gca ctt agt gat gga act
1412
Leu Asn Pro Asp Gly Thr Val Lys His Phe Ala Leu Ser Asp Gly Thr
    340                 345                 350

caa ata act gga gat gct tat gtt tgt gca aca cca gtc gat atc ttc
1460
Gln Ile Thr Gly Asp Ala Tyr Val Cys Ala Thr Pro Val Asp Ile Phe
355                 360                 365                 370

aag ctt ctt gta cct caa gag tgg agt gaa att act tat ttc aag aaa
1508
Lys Leu Leu Val Pro Gln Glu Trp Ser Glu Ile Thr Tyr Phe Lys Lys
                375                 380                 385

ctg gag aag ttg gtg gga gtt cct gtt atc aat gtt cat ata tgg ttt
1556
Leu Glu Lys Leu Val Gly Val Pro Val Ile Asn Val His Ile Trp Phe
            390                 395                 400

gac aga aaa ctg aac aac aca tat gac cac ctt ctt ttc agc agg agt
1604
Asp Arg Lys Leu Asn Asn Thr Tyr Asp His Leu Leu Phe Ser Arg Ser
        405                 410                 415

tca ctt tta agt gtc tat gca gac atg tca gta acc tgc aag gaa tac
1652
Ser Leu Leu Ser Val Tyr Ala Asp Met Ser Val Thr Cys Lys Glu Tyr
    420                 425                 430
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tat gac cca aac cgt tca atg ctg gag ttg gtc ttt gct cct gca gac
1700
Tyr Asp Pro Asn Arg Ser Met Leu Glu Leu Val Phe Ala Pro Ala Asp
435 440 445 450

gaa tgg att ggt cga agt gac act gaa atc atc gat gca act atg gaa
1748
Glu Trp Ile Gly Arg Ser Asp Thr Glu Ile Ile Asp Ala Thr Met Glu
455 460 465

gag cta gcc aag tta ttt cct gat gaa att gct gct gat cag agt aaa
1796
Glu Leu Ala Lys Leu Phe Pro Asp Glu Ile Ala Ala Asp Gln Ser Lys
470 475 480

gca aag att ctt aag tat cat att gtg aag aca ccg aga tcg gtt tac
1844
Ala Lys Ile Leu Lys Tyr His Ile Val Lys Thr Pro Arg Ser Val Tyr
485 490 495

aaa act gtc cca aac tgt gag cct tgc cgg cct ctc caa agg tca cct
1892
Lys Thr Val Pro Asn Cys Glu Pro Cys Arg Pro Leu Gln Arg Ser Pro
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atc gaa ggt ttc tat cta gct ggt gat tac aca aag cag aaa tac ctg
1940
Ile Glu Gly Phe Tyr Leu Ala Gly Asp Tyr Thr Lys Gln Lys Tyr Leu
515 520 525 530

gct tct atg gaa ggt gca gtc cta tcc ggg aag ctt tgt gcc cag tcc
1988
Ala Ser Met Glu Gly Ala Val Leu Ser Gly Lys Leu Cys Ala Gln Ser
535 540 545

ata gtg cag gat tat agc agg ctc gca ctc agg agc cag aaa agc cta
2036
Ile Val Gln Asp Tyr Ser Arg Leu Ala Leu Arg Ser Gln Lys Ser Leu
550 555 560

caa tca gga gaa gtt ccc gtc cca tct tag ttgtagttgg ctttagctat
2086
Gln Ser Gly Glu Val Pro Val Pro Ser
565 570

cgtcatcccc actgggtgct atcttatctc ctatttcaat gggaacccac ccaatggtca
2146

tgttggagac aacacctgtt atggtccttt gaccatctcg tggtgactgt agttgatgtc
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Ser His Tyr Thr Ser Phe Ala Val Lys Lys Leu Val Ser Arg Asn Lys
        35                  40                  45
Gly Arg Arg Ser His Arg Arg His Pro Ala Leu Gln Val Val Cys Lys
    50                  55                  60
Asp Phe Pro Arg Pro Pro Leu Glu Ser Thr Ile Asn Tyr Leu Glu Ala
65                  70                  75                  80
Gly Gln Leu Ser Ser Phe Phe Arg Asn Ser Glu Arg Pro Ser Lys Pro
                85                  90                  95
Leu Gln Val Val Val Ala Gly Ala Gly Leu Ala Gly Leu Ser Thr Ala
            100                 105                 110
Lys Tyr Leu Ala Asp Ala Gly His Lys Pro Ile Leu Leu Glu Ala Arg
        115                 120                 125
Asp Val Leu Gly Gly Lys Val Ala Ala Trp Lys Asp Glu Asp Gly Asp
    130                 135                 140
Trp Tyr Glu Thr Gly Leu His Ile Phe Phe Gly Ala Tyr Pro Asn Ile
145                 150                 155                 160
Gln Asn Leu Phe Gly Glu Leu Arg Ile Glu Asp Arg Leu Gln Trp Lys
                165                 170                 175
Glu His Ser Met Ile Phe Ala Met Pro Asn Lys Pro Gly Glu Phe Ser
            180                 185                 190
Arg Phe Asp Phe Pro Glu Thr Leu Pro Ala Pro Ile Asn Gly Ile Trp
        195                 200                 205
Ala Ile Leu Arg Asn Asn Glu Met Leu Thr Trp Pro Glu Lys Val Lys
    210                 215                 220
Phe Ala Ile Gly Leu Leu Pro Ala Met Val Gly Gly Gln Pro Tyr Val
225                 230                 235                 240
Glu Ala Gln Asp Gly Leu Thr Val Ser Glu Trp Met Lys Lys Gln Gly
                245                 250                 255
Val Pro Asp Arg Val Asn Asp Glu Val Phe Ile Ala Met Ser Lys Ala
            260                 265                 270
Leu Asn Phe Ile Asn Pro Asp Glu Leu Ser Met Gln Cys Ile Leu Ile
        275                 280                 285
Ala Leu Asn Arg Phe Leu Gln Glu Lys His Gly Ser Lys Met Ala Phe
    290                 295                 300
Leu Asp Gly Asn Pro Pro Glu Arg Leu Cys Met Pro Ile Val Asp His
305                 310                 315                 320
Ile Arg Ser Arg Gly Gly Glu Val Arg Leu Asn Ser Arg Ile Lys Lys
                325                 330                 335
Ile Glu Leu Asn Pro Asp Gly Thr Val Lys His Phe Ala Leu Ser Asp
            340                 345                 350
Gly Thr Gln Ile Thr Gly Asp Ala Tyr Val Cys Ala Thr Pro Val Asp
        355                 360                 365
Ile Phe Lys Leu Leu Val Pro Gln Glu Trp Ser Glu Ile Thr Tyr Phe
    370                 375                 380
Lys Lys Leu Glu Lys Leu Val Gly Val Pro Val Ile Asn Val His Ile
385                 390                 395                 400
Trp Phe Asp Arg Lys Leu Asn Asn Thr Tyr Asp His Leu Leu Phe Ser
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405 410 415
Arg Ser Ser Leu Leu Ser Val Tyr Ala Asp Met Ser Val Thr Cys Lys
420 425 430
Glu Tyr Tyr Asp Pro Asn Arg Ser Met Leu Glu Leu Val Phe Ala Pro
435 440 445
Ala Asp Glu Trp Ile Gly Arg Ser Asp Thr Glu Ile Ile Asp Ala Thr
450 455 460
Met Glu Glu Leu Ala Lys Leu Phe Pro Asp Glu Ile Ala Ala Asp Gln
465 470 475 480
Ser Lys Ala Lys Ile Leu Lys Tyr His Ile Val Lys Thr Pro Arg Ser
485 490 495
Val Tyr Lys Thr Val Pro Asn Cys Glu Pro Cys Arg Pro Leu Gln Arg
500 505 510
Ser Pro Ile Glu Gly Phe Tyr Leu Ala Gly Asp Tyr Thr Lys Gln Lys
515 520 525
Tyr Leu Ala Ser Met Glu Gly Ala Val Leu Ser Gly Lys Leu Cys Ala
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97
Arg Cys Phe Ala Ser Ser Ser Ile Gln Ala Leu Lys Gly Ser Gln His
20 25 30

gtg agc ttt gga gtg aaa tct ctt gtc tta agg aat aaa gga aaa aga
145
Val Ser Phe Gly Val Lys Ser Leu Val Leu Arg Asn Lys Gly Lys Arg
35 40 45

ttc cgt cgg agg ctc ggt gct cta cag gtt gtt tgc cag gac ttt cca
193
Phe Arg Arg Arg Leu Gly Ala Leu Gln Val Val Cys Gln Asp Phe Pro
50 55 60

aga cct cca cta gaa aac aca ata aac ttt ttg gaa gct gga caa cta
241

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Arg Pro Pro Leu Glu Asn Thr Ile Asn Phe Leu Glu Ala Gly Gln Leu
 65                  70                  75

tcc tca ttt ttc aga aac agt gaa caa ccc act aaa cca tta cag gtc
289
Ser Ser Phe Phe Arg Asn Ser Glu Gln Pro Thr Lys Pro Leu Gln Val
 80                  85                  90                  95

gtg att gct gga gca gga tta gct ggt tta tca acg gca aaa tat ctg
337
Val Ile Ala Gly Ala Gly Leu Ala Gly Leu Ser Thr Ala Lys Tyr Leu
                100                 105                 110

gca gat gct ggt cat aaa ccc ata ttg ctt gag gca agg gat gtt ttg
385
Ala Asp Ala Gly His Lys Pro Ile Leu Leu Glu Ala Arg Asp Val Leu
            115                 120                 125

ggt gga aag ata gct gct tgg aag gat gaa gat gga gat tgg tat gaa
433
Gly Gly Lys Ile Ala Ala Trp Lys Asp Glu Asp Gly Asp Trp Tyr Glu
        130                 135                 140

act ggg ctt cat atc ttt ttt gga gct tat ccc aac ata cag aac ttg
481
Thr Gly Leu His Ile Phe Phe Gly Ala Tyr Pro Asn Ile Gln Asn Leu
    145                 150                 155

ttt ggc gag ctt ggt att aat gat cgg ttg caa tgg aag gaa cac tcc
529
Phe Gly Glu Leu Gly Ile Asn Asp Arg Leu Gln Trp Lys Glu His Ser
160                 165                 170                 175

atg ata ttt gcc atg cca aac aag cca gga gaa tcc agc cgg ttt gat
577
Met Ile Phe Ala Met Pro Asn Lys Pro Gly Glu Ser Ser Arg Phe Asp
                180                 185                 190

ttt cct gaa aca ttg cct gca ccc tta aat gga ata tgg gcc ata cta
625
Phe Pro Glu Thr Leu Pro Ala Pro Leu Asn Gly Ile Trp Ala Ile Leu
            195                 200                 205

aga aac aat gaa atg cta act tgg cca gag aag gtg aag ttt gct ctt
673
Arg Asn Asn Glu Met Leu Thr Trp Pro Glu Lys Val Lys Phe Ala Leu
        210                 215                 220

gga ctt ttg cca gca atg gtt ggt ggc caa gct tat gtt gaa gct caa
721
Gly Leu Leu Pro Ala Met Val Gly Gly Gln Ala Tyr Val Glu Ala Gln
    225                 230                 235

gat ggt ttt act gtt tct gag tgg atg aaa aag cag ggt gtt cct gat
769
Asp Gly Phe Thr Val Ser Glu Trp Met Lys Lys Gln Gly Val Pro Asp
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240                 245                 250                 255

cga gtg aac gat gaa gtt ttc att gca atg tca aag gca ctt aat ttc
817
Arg Val Asn Asp Glu Val Phe Ile Ala Met Ser Lys Ala Leu Asn Phe
                260                 265                 270

ata aat cct gat gag tta tcc atg cag tgc att ctg att gct tta aac
865
Ile Asn Pro Asp Glu Leu Ser Met Gln Cys Ile Leu Ile Ala Leu Asn
            275                 280                 285

cga ttt ctt cag gag aag cat ggt tct aag atg gca ttc ttg gat ggt
913
Arg Phe Leu Gln Glu Lys His Gly Ser Lys Met Ala Phe Leu Asp Gly
        290                 295                 300

aat cct cct gaa agg tta tgc atg cct att gtt gac cat gtt cgc tct
961
Asn Pro Pro Glu Arg Leu Cys Met Pro Ile Val Asp His Val Arg Ser
    305                 310                 315

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1009
Leu Gly Gly Glu Val Arg Leu Asn Ser Arg Ile Gln Lys Ile Glu Leu
320                 325                 330                 335

aat cct gat gga aca gtg aaa cac ttt gca ctt acc gat gga act caa
1057
Asn Pro Asp Gly Thr Val Lys His Phe Ala Leu Thr Asp Gly Thr Gln
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1105
Ile Thr Gly Asp Ala Tyr Val Phe Ala Thr Pro Val Asp Ile Leu Lys
            355                 360                 365

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1153
Leu Leu Val Pro Gln Glu Trp Lys Glu Ile Ser Tyr Phe Lys Lys Leu
        370                 375                 380

gag aag ttg gtg gga gtt cct gtt ata aat gtt cat ata tgg ttt gat
1201
Glu Lys Leu Val Gly Val Pro Val Ile Asn Val His Ile Trp Phe Asp
    385                 390                 395

aga aaa ctg aag aac aca tat gac cac ctt ctt ttc agc agg agt tca
1249
Arg Lys Leu Lys Asn Thr Tyr Asp His Leu Leu Phe Ser Arg Ser Ser
400                 405                 410                 415

ctt tta agt gtt tat gcg gac atg tca gta act tgc aag gaa tac tat
1297
Leu Leu Ser Val Tyr Ala Asp Met Ser Val Thr Cys Lys Glu Tyr Tyr
                420                 425                 430
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1345
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tgg gtt gga cgg agt gac act gaa atc atc gaa gca act atg caa gag
1393
Trp Val Gly Arg Ser Asp Thr Glu Ile Ile Glu Ala Thr Met Gln Glu
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cta gcc aag cta ttt cct gat gaa att gct gct gat cag agt aaa gca
1441
Leu Ala Lys Leu Phe Pro Asp Glu Ile Ala Ala Asp Gln Ser Lys Ala
    465                 470                 475

aag att ctg aag tat cat gtt gtg aag aca cca aga tct gtt tac aag
1489
Lys Ile Leu Lys Tyr His Val Val Lys Thr Pro Arg Ser Val Tyr Lys
480                 485                 490                 495

act atc ccg gac tgt gaa cct tgc cga cct ctg caa aga tca ccg att
1537
Thr Ile Pro Asp Cys Glu Pro Cys Arg Pro Leu Gln Arg Ser Pro Ile
                500                 505                 510

gaa ggg ttc tat cta gct ggt gac tac aca aag cag aaa tat ttg gct
1585
Glu Gly Phe Tyr Leu Ala Gly Asp Tyr Thr Lys Gln Lys Tyr Leu Ala
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tcg atg gag ggt gca gtt cta tct ggg aag ctt tgt gct cag tct gta
1633
Ser Met Glu Gly Ala Val Leu Ser Gly Lys Leu Cys Ala Gln Ser Val
         530                 535                 540

gtg gag gat tat aaa atg cta tct cgt agg agc ctg aaa agt ctg cag
1681
Val Glu Asp Tyr Lys Met Leu Ser Arg Arg Ser Leu Lys Ser Leu Gln
    545                 550                 555

tcc gaa gtt cct gtt gcc tcc tag ttgtagtcag gactattccc aatggtgtgt
1735
Ser Glu Val Pro Val Ala Ser
560                 565

gtgtcatcat cccctagtca gtttttttct atttagtggg tgcccaactc tccaccaatt
1795

tacacatgat ggaacttgaa agatgcctat tttggtctta tcatatttct gtaaagttga
1855

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1915
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gacctgcata gtaattctta gacttttgca aaaggcaaaa ggggtaaagc gacctttttt
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35 40 45
Arg Arg Arg Leu Gly Ala Leu Gln Val Val Cys Gln Asp Phe Pro Arg
50 55 60
Pro Pro Leu Glu Asn Thr Ile Asn Phe Leu Glu Ala Gly Gln Leu Ser
65 70 75 80
Ser Phe Phe Arg Asn Ser Glu Gln Pro Thr Lys Pro Leu Gln Val Val
85 90 95
Ile Ala Gly Ala Gly Leu Ala Gly Leu Ser Thr Ala Lys Tyr Leu Ala
100 105 110
Asp Ala Gly His Lys Pro Ile Leu Leu Glu Ala Arg Asp Val Leu Gly
115 120 125
Gly Lys Ile Ala Ala Trp Lys Asp Glu Asp Gly Asp Trp Tyr Glu Thr
130 135 140
Gly Leu His Ile Phe Phe Gly Ala Tyr Pro Asn Ile Gln Asn Leu Phe
145 150 155 160
Gly Glu Leu Gly Ile Asn Asp Arg Leu Gln Trp Lys Glu His Ser Met
165 170 175
Ile Phe Ala Met Pro Asn Lys Pro Gly Glu Ser Ser Arg Phe Asp Phe
180 185 190
Pro Glu Thr Leu Pro Ala Pro Leu Asn Gly Ile Trp Ala Ile Leu Arg
195 200 205
Asn Asn Glu Met Leu Thr Trp Pro Glu Lys Val Lys Phe Ala Leu Gly
210 215 220
Leu Leu Pro Ala Met Val Gly Gly Gln Ala Tyr Val Glu Ala Gln Asp
225 230 235 240
Gly Phe Thr Val Ser Glu Trp Met Lys Lys Gln Gly Val Pro Asp Arg
245 250 255
Val Asn Asp Glu Val Phe Ile Ala Met Ser Lys Ala Leu Asn Phe Ile
260 265 270
Asn Pro Asp Glu Leu Ser Met Gln Cys Ile Leu Ile Ala Leu Asn Arg
275 280 285
Phe Leu Gln Glu Lys His Gly Ser Lys Met Ala Phe Leu Asp Gly Asn
290 295 300
Pro Pro Glu Arg Leu Cys Met Pro Ile Val Asp His Val Arg Ser Leu
305 310 315 320
Gly Gly Glu Val Arg Leu Asn Ser Arg Ile Gln Lys Ile Glu Leu Asn
325 330 335
Pro Asp Gly Thr Val Lys His Phe Ala Leu Thr Asp Gly Thr Gln Ile

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    370                 375                 380
Lys Leu Val Gly Val Pro Val Ile Asn Val His Ile Trp Phe Asp Arg
385                 390                 395                 400
Lys Leu Lys Asn Thr Tyr Asp His Leu Leu Phe Ser Arg Ser Ser Leu
                405                 410                 415
Leu Ser Val Tyr Ala Asp Met Ser Val Thr Cys Lys Glu Tyr Tyr Asp
            420                 425                 430
Pro Ser Arg Ser Met Leu Glu Leu Val Phe Ala Pro Ala Glu Glu Trp
        435                 440                 445
Val Gly Arg Ser Asp Thr Glu Ile Ile Glu Ala Thr Met Gln Glu Leu
    450                 455                 460
Ala Lys Leu Phe Pro Asp Glu Ile Ala Ala Asp Gln Ser Lys Ala Lys
465                 470                 475                 480
Ile Leu Lys Tyr His Val Val Lys Thr Pro Arg Ser Val Tyr Lys Thr
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Ile Pro Asp Cys Glu Pro Cys Arg Pro Leu Gln Arg Ser Pro Ile Glu
            500                 505                 510
Gly Phe Tyr Leu Ala Gly Asp Tyr Thr Lys Gln Lys Tyr Leu Ala Ser
        515                 520                 525
Met Glu Gly Ala Val Leu Ser Gly Lys Leu Cys Ala Gln Ser Val Val
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Glu Asp Tyr Lys Met Leu Ser Arg Arg Ser Leu Lys Ser Leu Gln Ser
545                 550                 555                 560
Glu Val Pro Val Ala Ser
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